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Ultraslow Stretching of Polymer Gels in Solvents KENJI URAYAMA, Kyoto University, AKIHIRO KONDA, TOSHIKAZU TAKIGAWA —
We have investigated the nonlinear stress-strain relations and deformation behavior of a highly swollen polymer gel (with a length of ca. 5 cm and a thickness of ca. 5 mm) in solvents under ultraslow stretching rates (in the order of 0.1 micrometer/sec) that are comparable to or slower than the time scale of the diffusion of the gel. Under conventional tensile speeds, the stress-strain relations are independent of stretching rate and the Poisson's ratio is close to 0.5. In contrast, when the stretching rate is comparable to the diffusion rate of networks, the effects of stretching-induced swelling during elongation become pronounced: The induced swelling causes a reduction in Poisson's ratio as well as a decrease in stress. As a result, we observe a marked dependence of Poisson's ratio and stress-strain relations on stretching speeds in the corresponding time scale. In the extremely slow stretching, the induced swelling is fully equilibrated during elongation: The corresponding Poisson's ratio is ca. 0.25. In such slow strain-rate region, the mechanical properties become independent of strain rate again.

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